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THE EFFECT OF THE MODIFICATION OF THE BLEEDING METHOD FOR REGULATION OF THE IMPELLER PUMP EFFICIENCY***

SUMMARY

In the thesis the experimental research results are presented concerning possibilities of the use of the additional angular momentum of a stream under suction as a factor enabling regulation of the impeller pump efficiency with maintaining a constant pressure value.

Keywords: *impeller pump, regulation of the impeller pump, prerotation*

EFEKT MODYFIKACJI UPUSTOWEJ METODY REGULACJI WYDAJNOŚCI POMP WIROWYCH

W pracy przedstawiono wyniki badań eksperymentalnych, dotyczących możliwości wykorzystania dodatkowego krętu zasysanej strugi, jako czynnika umożliwiającego regulację wydajności pompy wirowej przy zachowaniu stałej wartości ciśnienia.

Słowa kluczowe: *pompa wirowa, regulacja pomp wirowych, prerotacja*

DESIGNATION LIST

- $\dot{V}$ – pump output
- $\dot{V}_K$ – pump output restricted to permanent rotation number
- $\dot{V}_p$ – prerotational stream
- H, H_u – practical lifting height
- H_{uk} – practical lifting height restricted to permanent rotation number
- P_t, P_s – forcing pressure, suction pressure
- Δh – pressure loss head
- n – pump rotations
- η – general efficiency of a pump

1. INTRODUCTION

Flow parameters which characterize the performance of the impeller pump which means its efficiency as well as the increase in the total pressure called a practical height of lifting are connected with each other by the curve of throttling. From the mathematical point of view the throttling curve is the geometrical spot of the so called working points meaning the points of of crossing lines of the pump and the net resistance characteristics. This variety of possible to gain working parameter values results from the rotational quality of the flow machines which can be called selfregulation, that is the ability of the pump to automatically adapt itself to the net resistance. The impeller pump is thus a machine whose working parameters can be controlled.

In practice the regulation of the impeller pump usually means the change of only one of the basic working parameters, mainly of the efficiency. It is known, however, that no matter what regulation method is applied the change of the efficiency happens simultaneously with the change of the lifting height. The size of the latter change mainly depends on the shape of the throttling curve, from the ratio between the static and dynamic height of the net resistance as well as the applied regulation method. The comparison of the course of the most common methods for regulation of the impeller pump efficiency is presented schematically in the Figure 1.

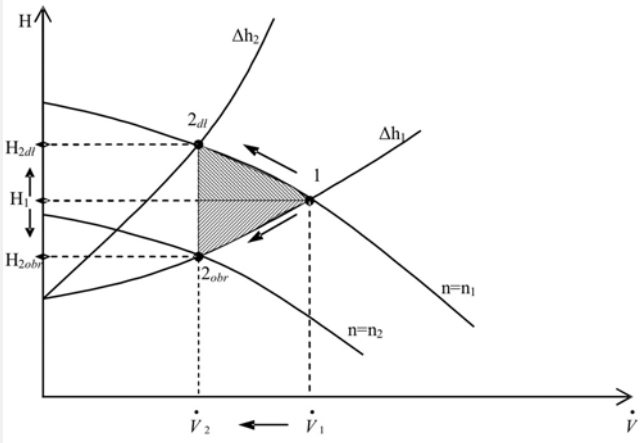

Fig. 1. The comparison of the regulation process of the impeller pump efficiency by throttling in the pressure conduit as well as by the change of revolutions

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*** Scientific thesis financed from the university provisions for the years 2006–2009 as the research project No 520047. 31/0773

Thus it may happen that in technological processes requiring the constant fluid pressure, independently of the pump efficiency, classic methods of regulation will not be able to be applied.

Apart from the mentioned regulation methods the method of bleeding is also used. It demands installing of a parallelly introduced duct into the piston part of the pumping system at a regulated height of the hydraulic resistance. Enlarging of the summary flow cross-section causes the increase of the pump efficiency, however, along with the decrease of pressure in the stream directed to the reception (Fig. 2).

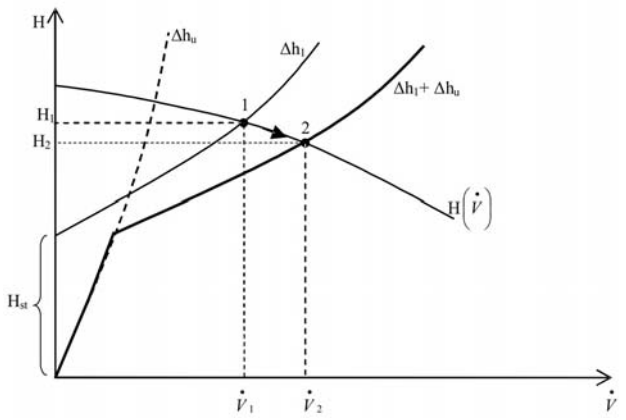


Fig. 2. The bleeding regulation of the impeller pump

2. RESEARCH

Optimal working conditions of an impeller pump are created only when the geometry of the sucked – in stream is identical with the curvature at the beginning of the blades that is when the liquid flow is static.

This is one of the assumptions in the design process of the pump which means that obtaining the static flow happens only when the pump output is equal with the assumed computational (rated) output. For the outputs of the rest of pumps an unbounded flow proceeds with separating or thrusting of the stream at the inlet causing additional losses, which is a reason for the decrease of efficiency.

Interference of the natural prerotation of the sucked-in stream with the additionally created angular momentum causes the change of conditions of the stream pressure at the inlet edges of the impeller blades. As a result in the enlarged area of work an optimum static fluid pressure at the rotating grid of blades can be achieved, which is a condition for minimizing of pressure waste in the suction area of the pumping system.

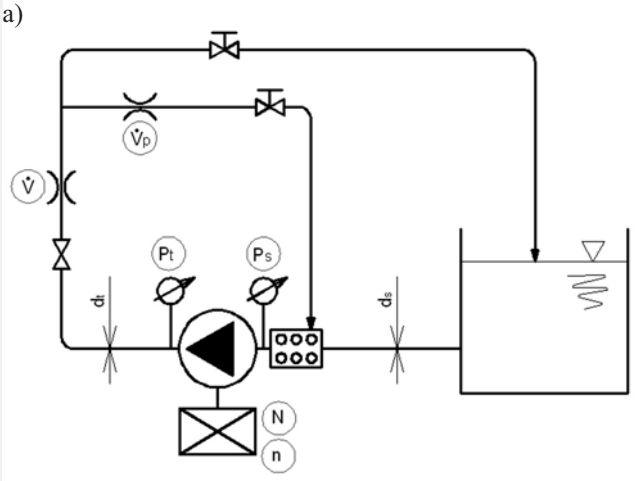
In the present thesis a modernized way of affecting the sucked stream of fluid by generating additional prerotation in the area directly in front of the pump impeller. In Figure 3a diagram of the measuring layout is presented, whereas the principle of the prerotational attachment operation is shown in the Figure 3b.

The spin was achieved by means of the part of the stream drained from the pressing area and introduced tangentially to the end of the section of the suction conduit directly in front of the impeller by means of a special measuring head.

The results of the conducted experimental research indicate a possibility of a significant decrease of the pump efficiency by means of a considerably smaller stream drained from the piston area. The final effect of regulation is achieved in conditions of constant pressure. (Figs 4 and 5).

An additional advantage of the recommended innovation can be connected with the increase of the pump efficiency in the working area below the nominal efficiency (Figs 6 and 7).

a)



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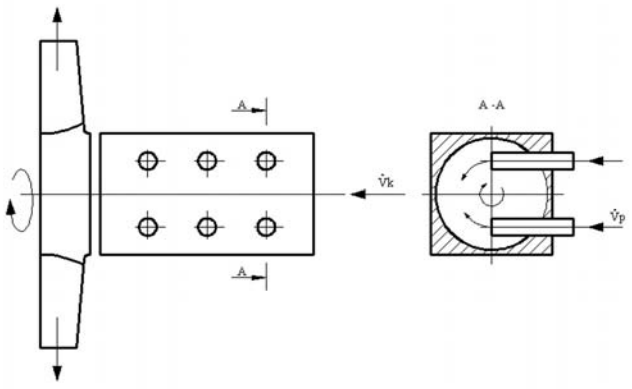

Fig. 3. Measuring position diagram (a), the scheme of producing of additional prerotation in the mouth piece (adjutage) in front of the impeller (b)

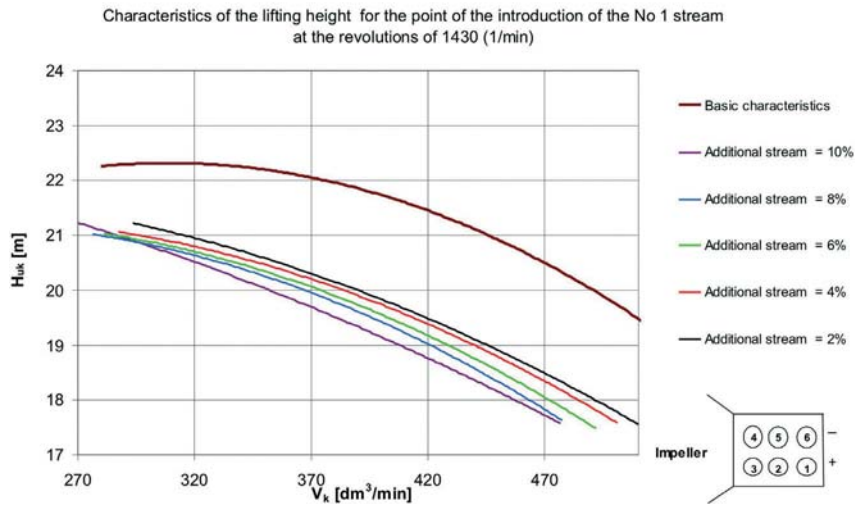

Fig. 4. The influence of the size of the prerotational stream on the throttling curve for $n = n_{nom}$

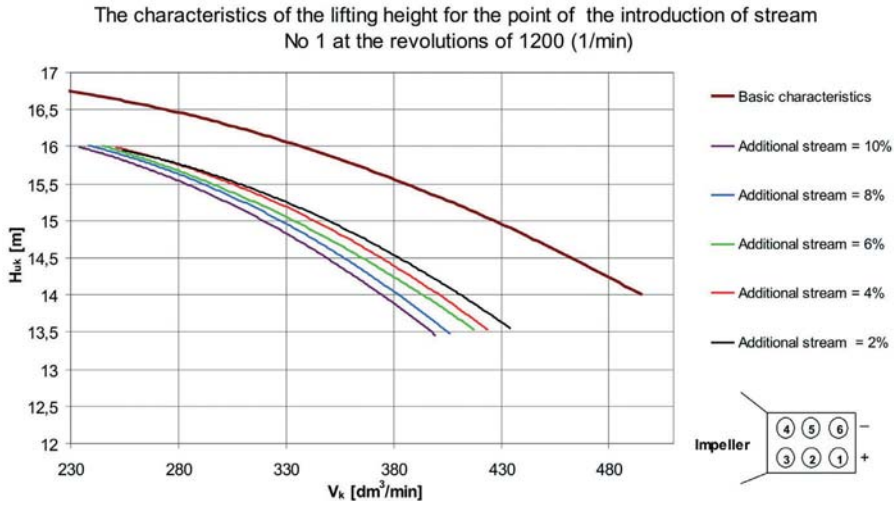

Fig. 5. The influence of the size of the prerotational stream on the throttling curve

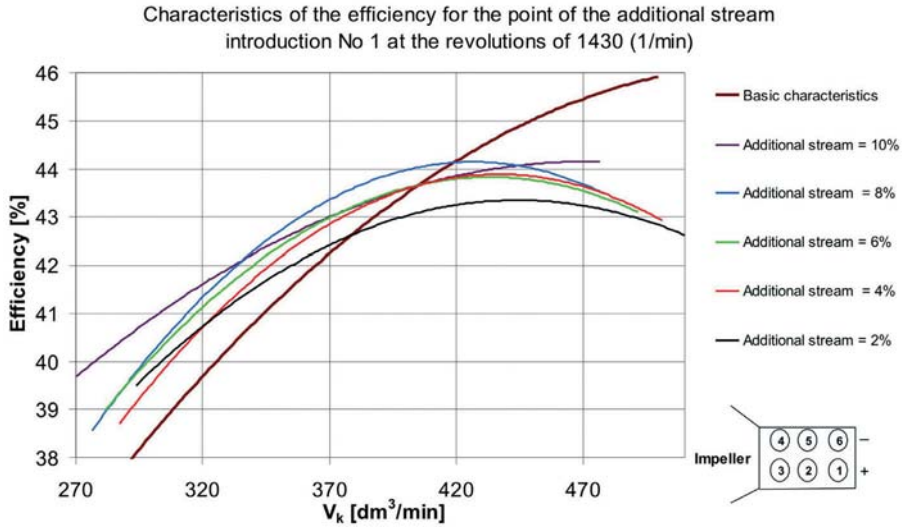

Fig. 6. The dependence of the pump efficiency and the value of the prerotary stream for $n = n_{nom}$

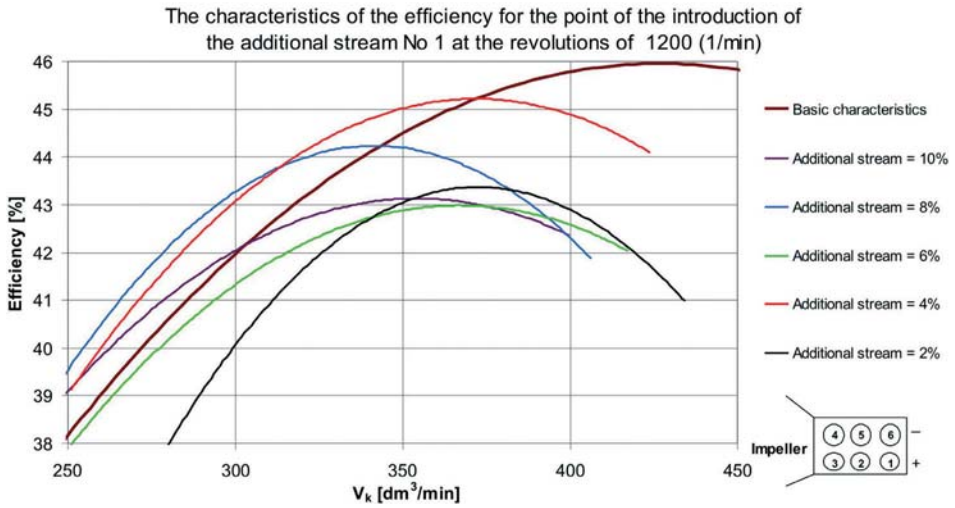

Fig. 7. The influence of the size of the prerotary stream on the course of the efficiency curve of the pump

3. CONCLUSION

The usefulness of the presented way of the impeller pump regulation is connected with the fact that with the use of relatively small amount of liquid drained from the delivery space it is possible to reduce the output considerably. Moreover, overregulating of the pump proceeds without the change of the pressure. In the research area it has been found that the presented method can be applied in the area of small outputs which means where the pump operation is bound with the big energy-consumption of the pumping process. The application of this method is useful in the area of small outputs where the pump is slightly prone to the cavitation of the liquid. What is more, directing the part of the liquid from the delivery space to the suction space causes the additional increase of resistance to the appearing of cavitation.

The hitherto achieved results of the conducted experiment (noted for two values of the pump revolutions:

$n = n_{nom} = 1430$ 1/min as well as $n = 0.8\ n_{nom}$)

indicate the advisability of more detailed research projects which will enable establishing of the regulation parameters providing an energy-efficient way of the impeller pump regulation.

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